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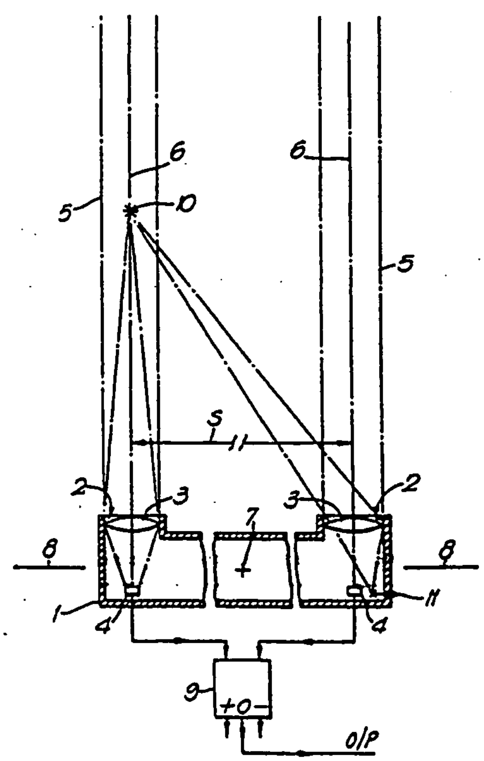
(54) Optical radiation sensitive apparatus.

(57) Infra-red surveillance apparatus adapted to discount short range objects. The apparatus comprises two lens having fields of view with parallel axes and a photo-electric detector positioned behind each lens. Comparator means operates so as only to pass signals resulting from an object in the field of view of both lenses.

Fig.1.



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OPTICAL RADIATION SENSITIVE APPARATUS

This invention relates to optical radiation (for example infra-red) radiation sensitive apparatus and more particularly, but not exclusively, to surveillance apparatus which scans a field-of-view and locates infra-red emissive targets such as aircraft and missiles within the scanned field-of-view.

Such apparatus often comprises some form of input optical system, a simple objective lens perhaps, which receives the infra-red radiation and directs it onto an infra-red responsive photo-electric sensor. In the case of a target surveillance scanner, the objective/sensor combination has a comparatively narrow instant field of view but the combination is mounted for rotation about horizontal and vertical axes so that the instant field of view can be scanned in elevation and azimuth over the overall field of view to be surveyed. A problem with such apparatus is that the input optical system gathers in radiation emanating from anywhere within its field-of-view, i.e. from any range (up to the maximum), which may not be desirable. For example, in the case of a target surveillance scanner, it may mean that the scanner is not able to distinguish between a nearby non-target item such as a bird and a distant true target.

Accordingly, one object of the invention is to provide optical radiation sensitive apparatus which is able to distinguish between optical sources at different ranges from the apparatus. Another object is to provide an infra-red sensitive target detecting apparatus which discounts apparent targets having a range to the apparatus which is less than a preset amount.

In accordance with this invention we provide optical radiation sensitive apparatus comprising two photo-electric sensors, means for receiving the electrical output signals formed by the sensors, and an input optical system which is operable for directing onto the sensors optical radiation received from a field of view so that radiation emanating from within a first range of distance to the apparatus is received by only one of said two sensors at any one time while radiation emanating from within a second range of distance to the apparatus is received by both sensors at the same time, and wherein the receiving means is adapted to discount signals resulting from optical radiation emanating from a predetermined one of the first and second ranges of distance.

Preferably, the receiving means is adapted to discount signals resulting from short range objects. In the embodiment to be described, the receiving means is operable to pass electrical output signals indicative of an object in the field of view from the two photo-electric sensors only when similar output signals are received from both of the sensors at the same time.

The input optical system may comprise two lenses or two lens/mirror combinations for directing incoming radiation onto the two photo-electric sensors, the lens or lens/mirror combinations having fields of view having parallel axes.

Alternatively, the input optical system may comprise two lenses or two lens/mirror combinations for directing incoming radiation onto the two photo-electric sensors, the lens or lens/mirror combinations having fields of view having converging axes.

For a better understanding of the invention, reference will be made, by way of example, to the accompanying drawings, in which:-

Figure 1 is a diagram illustrating the operations and some of the parts of an infra-red sensitive target surveillance scanner including, shown in section, an input optical system, and

Figures 2, 3 and 4 are sectioned diagrammatic views of respective modified input optical systems usable in the figure 1 scanner.

The figure 1 system comprises a quit long tubular housing 1 having two forward facing apertures 2 wherein there are mounted respective objective lenses 3. Behind the lenses 3, within the housing, are respective photo-electric sensors 4. The lens/sensor combinations have respective narrow fields of view 5 which each have a divergence of 0.6 milliradians and of which the axes 6 are parallel and spaced apart by a set distance, say 1.8 metres. The housing 1 is mounted for rotation about a vertical axis 7 and for turning about a horizontal axis 8 and is coupled to a drive motor system (not shown) which rotates and turns th housing so that the two fields of view 5 execute a helical scan pattern through an overall field of view to be surveyed. The outputs fom the sensors 4 are led to respective inputs of a comparator 9 which may be any of several types commercially available 'off-the-shelf' and which produces an output signal when, and only when, the output from both sensors are simultaneously such as to indicate that they are receiving radiation indicative of a target. As can be shown trigonometrically, the two sensors will only simultaneously rec ive radiation from a particular source if that source is at a range from the system equal to or greater than a minimum value R equal to S x 1000/W metres where S is the spacing between the focal axes 6 and W is the divergence of each field of view 5. For the given values of S and W, namely a distance of 1.8

metres between th axes 6 and a field of view divergence of 0.6 milliradians, the minimum rang value R comes to 3000 metres. Sources at ranges less than this value, for example th source 10 in the figure, may be imaged onto one of the sensors 4 but not, at the same time, onto the other. Instead, the source is imaged, as shown at 11, to one side of this other sensor. As the scanning continues, the image may of course move onto the other sensor but by then it will not be being imaged on the first sensor. As a result, the output signal from comparator 9 does not contain any indication of source 10. Conversely, a source (not shown) at a range greater than 3000 metres is imaged onto both sensors simultaneously and the comparator 9 provides an appropriate target detected signal.

The figure 1 system could be modified, for example as shown in figure 2, 3 or 4. In figure 2, the objective lenses 3 are removed from the apertures 2 and are instead positioned inside housing 1 between axis 7 and respective ones of the apertures 2 and with their optical axes aligned with axis 8. The two sensors 4 are repositioned to be next to each other near axis 7 and each facing its associated lens 3. Respective 45° angled mirrors 12 are positioned behind the apertures 2 to fold the incoming radiation around towards the lenses and sensors. In figure 3, the sensors are positioned as in figure 2 and the mirrors 12 are agin provided but the lenses 3 are each replaced by a combination of a concave mirror 13 with a hole 14 at its centre and a small mirror 15. Each mirror 13 lies between mirror 15 and the respective sensor 4 and has its concave reflecting surface facing the respective mirror 12. The reflecting surface of mirror 15 faces mirror 13. Incoming radiation received by either mirror 12 is folded towards the associated mirror 13 from whence it is reflected and converged back onto the associated mirror 15 and is there reflected again to reach sensor 4 via hole 14. In figure 4, the mirrors 12 are again provided as in figure 2 but the sensors 4 are now positioned intermediate axis 7 and a respective one of the mirrors 12, each facing and being associated with the other one of the mirrors 12. Meanwhile, the lenses 3 of figure 2 are replaced by a single lens 16 positioned at axis 7. Radiation received by either mirror 12 is now folded to travel past the sensor 4 nearest that mirror and to become focussed by lens 16 onto the associated sensor, i.e. the one furthest from the mirror. Thus the single lens 16 receives and focusses (in opposite directions) the radiation received by both mirrors 12.

Instead of the tubular housing 1 extending horizontally as shown, it may be preferred to have it extending vertically, i.e. along the axis 7, so then the apertures 2 are one above the other. The housing is still rotated about axis 7 and turned about axis 8. With this arrangement the optical components would be subject to less centrifugal force during the rotation about axis 7. Each sensor 4 could comprise a vertically extending linear array of photo-sites so that then the instant field of view of each sensor/lens combination still has the same azimuth dimension but a larger elevation dimension, i.e. in effect each senses several lines of the scanning pattern simultaneously. If the elevation dimension of the instant field of view is made sufficient to cover the desired elevation dimension of the overall field of view to be surveyed, then it is not necessary for the housing 1 to be able to turn about axis 8. Alternatively, it could turn about but not be driven to scan about that axis. The system would then be operable to scan an overall field of view having a depth dependent upon the sensor array length but can be re-set as and when required to cover a new elevation range. Naturally, such elevation adjustment can also be provided where the system is scanned in elevation e.g. by simply varying the average elevation direction of the system.

It will be further appreciated that the described concept of using a comparator two sensors and an appropriate optical system to achieve discounting of infra-red sources at a less than pre-determined range is applicable, not only to a target surveillance scanner of the kind described, but also to various other kinds of optical radiation sensitive apparatus.

Instead of having parallel field of view axes for the sensor/lens combinations, those axes could converge and be used, for example, to discount radiation sources at a greater than pre-determined range. Also, possibly, there could be more than two sensor/lens combinations all coupled to some appropriate comparator arrangement so as to achieve some desired range sensitivity pattern.

Claims

1. Optical radiation sensitive apparatus comprising two photo-electric sensors, means for receiving the electrical output signals formed by the sensors, and an imput optical system which is operable for directing onto the sensors optical radiation received from a field of view so that radiation emanating from within a first range of distance to the apparatus is received by only one of said two sensors at any one time while radiation emanating from within a second range of distance to the apparatus is received by both sensors at the same time, and wherein the receiving means is adapted to discount signals resulting from optical radiation emanating from a predetermined one of the first and second ranges of distance.

Apparatus according to claim 1 wherein the receiving means is adapted to discount signals resulting from short range objects..

3. Apparatus according to claim 1 or claim 2 wherein the receiving means is operable to pass electrical output signals indicative of an object in the field of view from the two photo-electric sensors only when similar output signals are received from both of the sensors at the same time.

4. Apparatus according to any preceding claim wherein the photo-electric sensors each comprise an array of photo-sites.

5. Apparatus according to any preceding claim wherein the input optical system comprises two lenses or two lens/mirror combinations for directing incoming radiation onto the two photo-electric sensors, the lens or lens/mirror combinations having fields of view having parallel axes.

6. Apparatus according to any one of claims 1 to 4 wherein the input optical system comprises two lenses or two lens/mirror combinations for directing incoming radiation onto the two photo-electric sensors, the lens or lens/mirror combinations having fields of view having converging axes.

7. Apparatus according to any preceding claim which is sensitive to infra-red radiation.

8. Apparatus according to any preceding claim which is operable to scan the field of view.

9. Surveillance apparatus for locating distant infra-red radiation sources, the apparatus comprising an input optical system defining two fields of view having spaced parallel axes such that said fields of view only begin to overlap at a substantial distance from the apparatus, two infra-red radiation responsive opto-electrical sensors positioned for having imaged thereon radiation sources which appear within respective ones of said fields of view and for then forming respective source indicative electrical signals, and means connected to the sensor and operable for providing a signal indicative of the co-existence of source indicative signals from both sensors.

Fig.1.

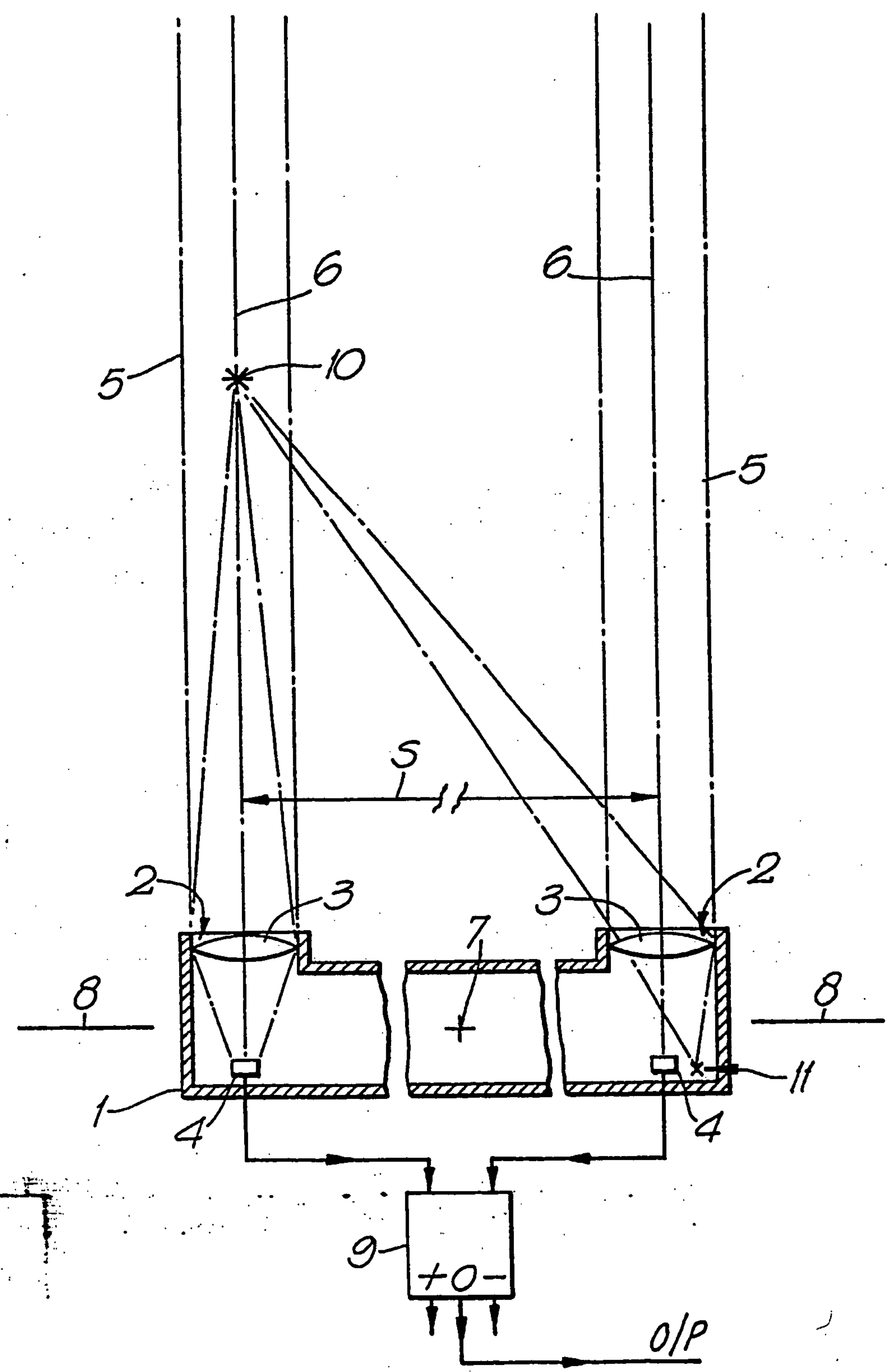


Fig. 2.

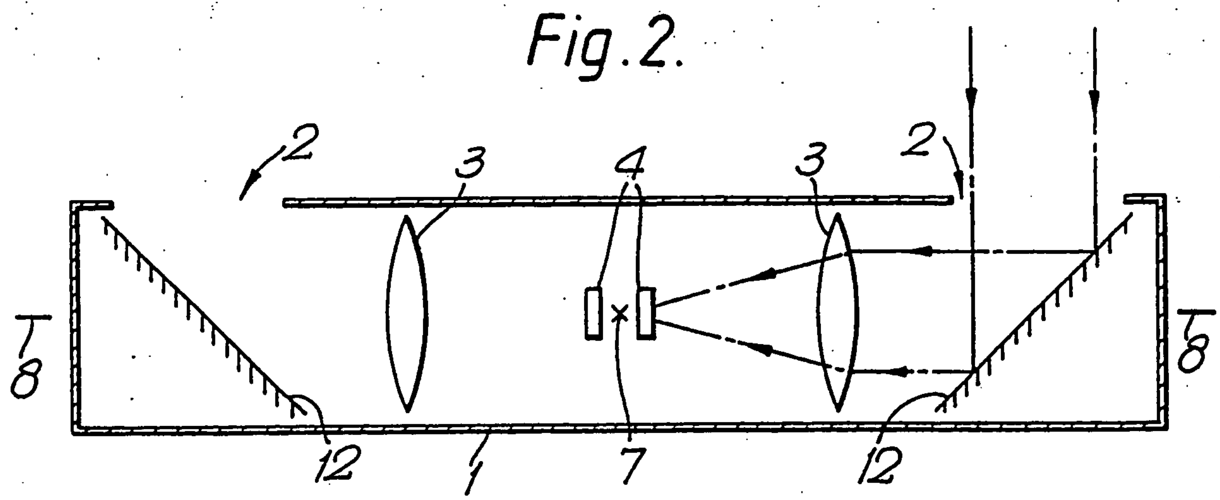


Fig. 3.

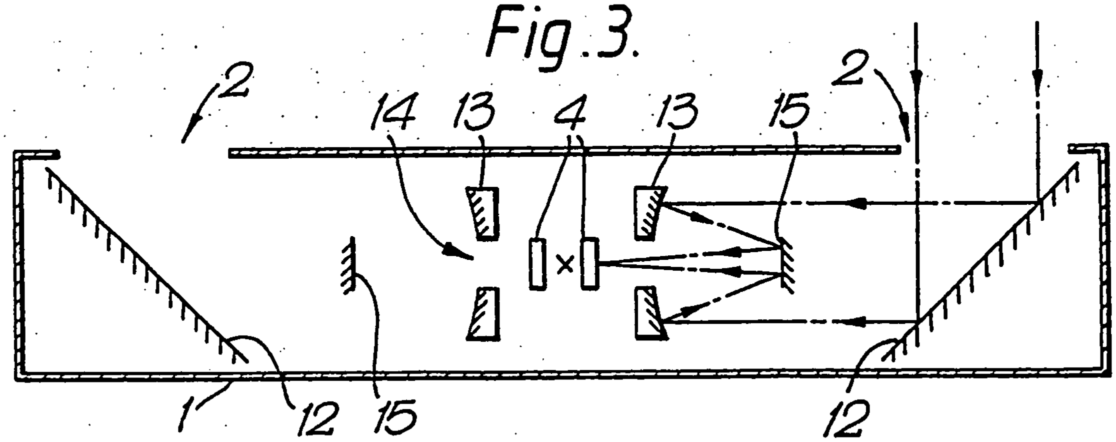
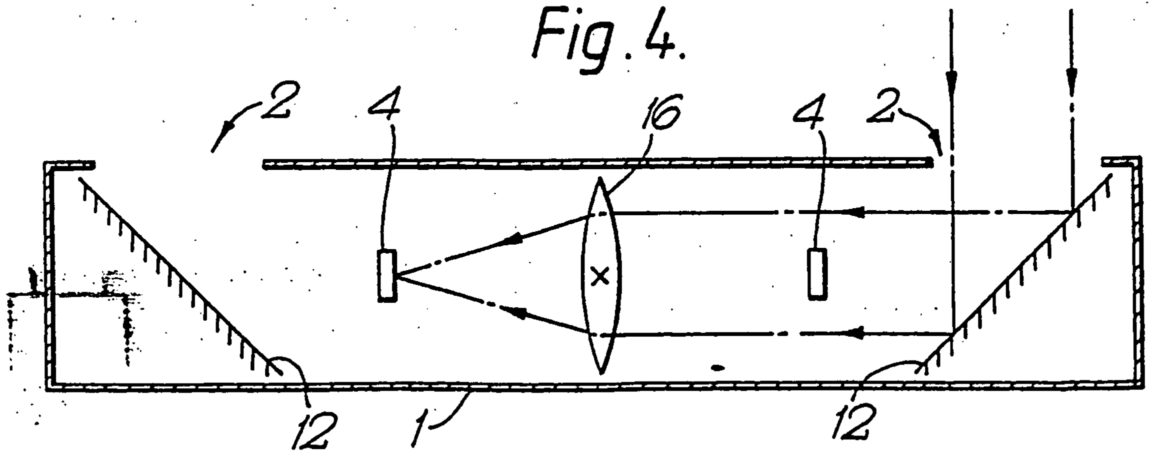


Fig. 4.



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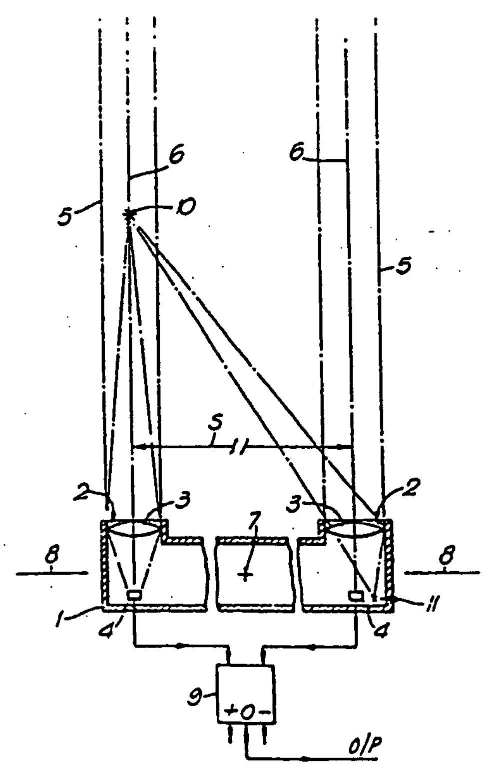
(54) Optical radiation sensitive apparatus.

(57) Infra-red surveillance apparatus adapted to discount short range objects (10). The apparatus comprises two lenses having fields of view with parallel axes (6) and a photo-electric detector (4) positioned behind each lens (3). Comparator means (9) operates so as only to pass signals resulting from an object in the field of view of both lenses.

Fig.1.



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EUROPEAN SEARCH REPORT

Application Number

EP 87 30 5982

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	DE-A1-2820304 (J.KUHBIER) * page 5, paragraph 2 - page 6 *	1, 7	G02B23/12 G06F15/66 G08B13/18
A	* claim 1 *	9	
A	EP-A-107042 (CERBERUS AG) * claims 2-4 *	3	
A	EP-A-80114 (ELTEC INSTRUMENTS AG) * figures 7, 10 *	5	
			TECHNICAL FIELDS SEARCHED (Int. Cl.4)
			G08B

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	05 DECEMBER 1989	FUCHS R.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
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